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PHOTOGRAPHIC
INTERPRETATION
REPORT

NATIONAL PHOTOGRAPHIC
INTERPRETATION CENTER

MODIFIED EXHAUST SYSTEMS AT SOVIET AIRCRAFT ENGINE TEST FACILITIES

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FEBRUARY 1974

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INSTALLATION OR ACTIVITY NAME					COUNTRY
Modified Exhaust Systems at Soviet Aircraft Engine Test Facilities					UR
UTM COORDINATES	GEOGRAPHIC COORDINATES	CATEGORY	BE NO.	COMIREX NO.	NIETB NO.
NA	See below	See below	See below	See below	See below

MAP REFERENCE

USATC, Series 200, scale 1:200,000 (See below for sheet number)

LATEST IMAGERY USED	NEGATION DATE (If required)
	NA

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Installation	Geographic Coordinates	Mrn No.	Map Sheet
Kuybyshev Experimental Aircraft & Rocket Engine Plant Krasnaya Glinka 2	53-20-27N 050-12-29E	004618	0165-17
Kuybyshev Aircraft Engine Plant Frunze 24	53-12-11N 050-16-38E	004623	0165-17
Moscow Aircraft Engine Plant 45	55-46-25N 037-43-03E	005253	0167-5
Omsk Aircraft and Missile Engine Plant Baranova 29	54-57-38N 073-25-11E	004258	0163-10
Perm Aircraft Engine Plant Stalin 19	57-58-34N 056-15-14E	003431	0156-11
Rybinsk Aircraft Engine Plant 36	58-03-11N 038-48-35E	002625	0154-13
Moscow Aircraft Engine Research Center Myachkovo, TsIAM	55-33-55N 037-56-37E	00568	0167-5

ABSTRACT

1. Test facilities at six Soviet aircraft engine plants are being modified in an effort to improve test capabilities. These same modifications have been made at Moscow Aircraft Engine Research Center Myachkovo, TsIAM, the major research and development facility for aircraft engines in the Soviet Union. Previous exhaust systems, including cylindrical towers, horizontal silencer tubes, and straight-through systems, have been replaced by large square concrete exhaust towers.

2. Improvements in test capabilities effected by these square exhaust towers include an 80 percent increase in air flow capacity over the older cylindrical exhaust towers and more efficient noise abatement. Both of these features would be requirements for testing a new generation of high-mass flow and/or higher velocity propulsion systems. These systems could include high-thrust turbojet, medium and high bypass turbofan, and afterburning turbofan engines.

3. The square exhaust towers have been identified in varying numbers at the seven Soviet aircraft engine facilities listed above. At two of the plants, Moscow Plant 45 and Rybinsk Plant 36, the square towers were erected as early as 1966; at the other four plants square towers were erected after 1969.

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4. Three of the top Soviet aircraft engine designers are associated with the six plants: the late S.K. Tumanskiy with Moscow Plant 45 and Rybinsk Plant 36, P.A. Solovyev with Perm Plant 19 and Omsk Plant 29, and N.D. Kuznetsov with Kuybyshev Plants 2 and 24. The most recent development from the Tumanskiy design bureau is the powerplant for the FOXBAT (MIG-25). The exact type of engine used in the FOXBAT is not known, but indications are that it is a high-thrust turbojet. Solovyev and Kuznetsov are primarily concerned with turbofans and are reported to be working on high-bypass ratio turbofan engines for large transports.

5. Six photographs, drawings, a map, and reference data are included in this report.

BASIC DESCRIPTION

6. Square exhaust towers have been installed on test cells at six Soviet aircraft engine plants and at the major Soviet aircraft engine R&D facility (Figure 1). In all cases the towers are square, divided into four equal-sized shafts (Figure 2). The opening of each shaft giving the tower a total exhaust port area This is an approximate increase of 275 square feet (or 82 percent) of exhaust port area over the largest cylindrical exhaust tower observed at any of these plants. The finished tower is covered and has two pairs of diametrically opposed exhaust ports in the top sides of the tower. The tower at Rybinsk Plant 36 was left uncovered and the four shafts exhaust vertically into the atmosphere.

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7. The square towers are probably constructed of precast concrete. The upper portion of the tower is identical in all cases; the tower base and positioning in respect to the test cell varies and will be described in detail for each plant.

8. Although only modifications to the exhaust towers have been observed, concurrent internal modifications have probably also been made to the engine test cells. There appears to be no correlation between the type of test cells to which the large exhaust towers have been adapted.

9. The new exhaust towers are part of a Soviet endeavor to upgrade their aircraft engine testing capabilities at design bureaus, production facilities, and the major aircraft engine R&D facility; the test cells at these facilities are somewhat antiquated and most likely not compatible with modern high-thrust, high-mass flow gas turbine engines. It appears that this modification program has been limited to the R&D facility and the six plants referenced in this report. These plants are associated with the major Soviet designers of large gas turbine engines.[1] As the requirement for high-thrust

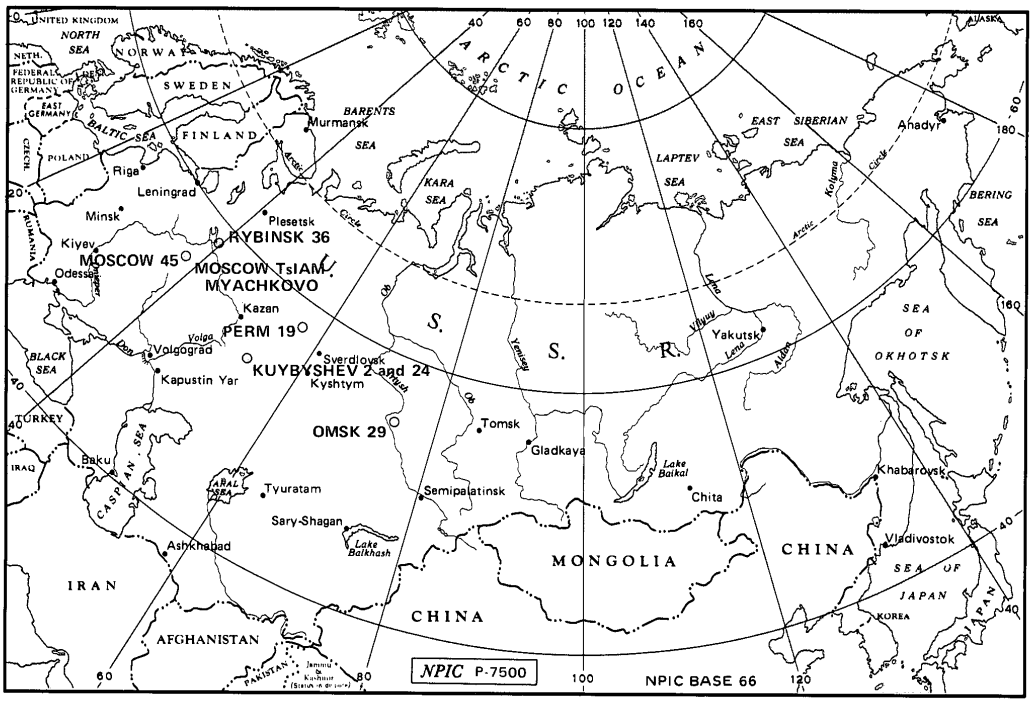

FIGURE 1. LOCATIONS OF SOVIET AIRCRAFT ENGINE FACILITIES WITH SQUARE TEST CELL EXHAUST TOWERS

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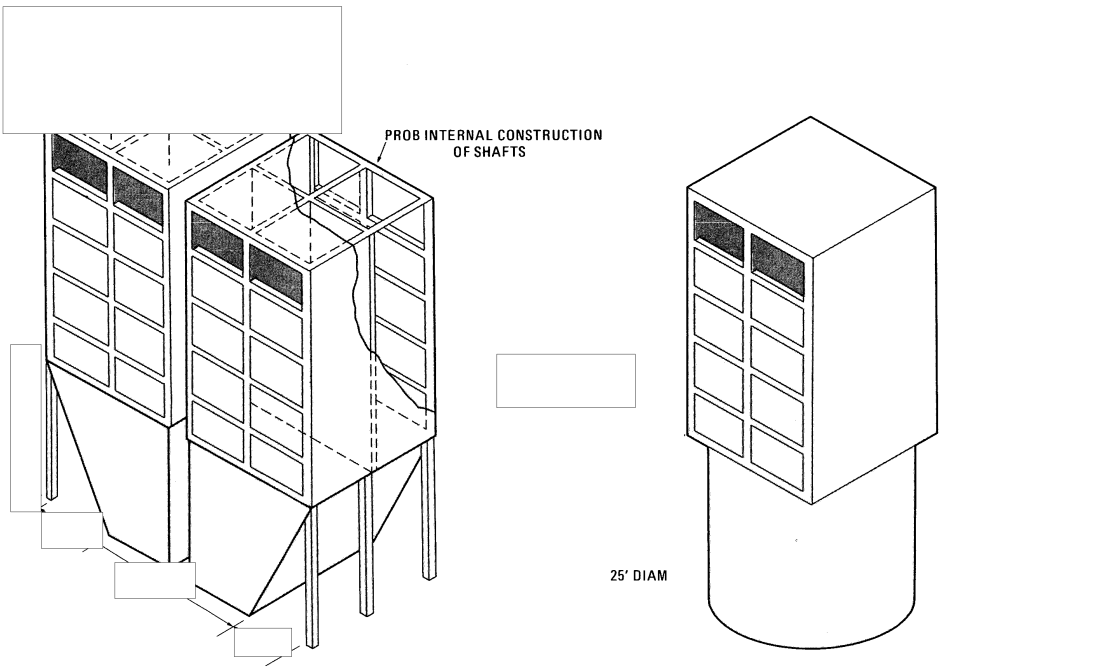

FIGURE 2. PERSPECTIVE DRAWINGS OF SQUARE EXHAUST TOWERS

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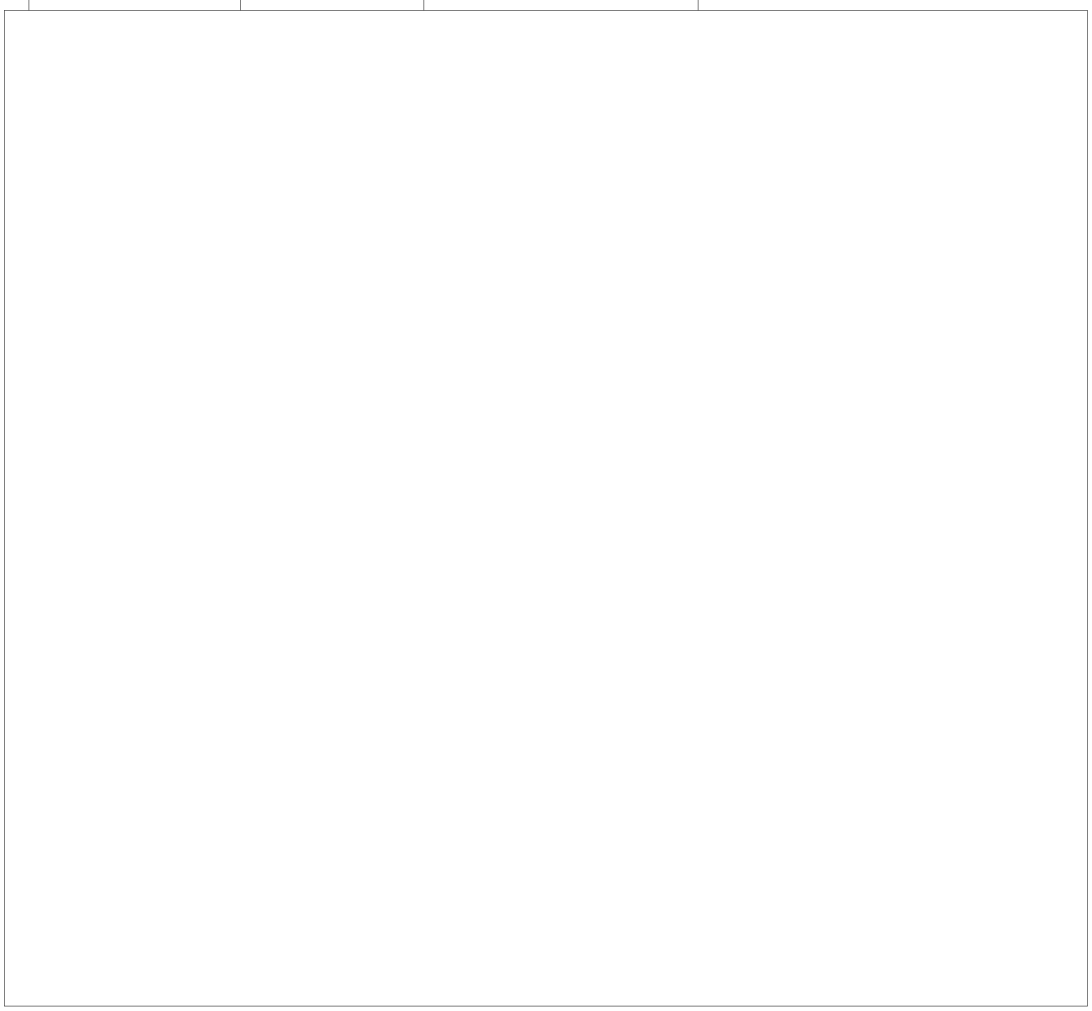

and high-mass flow propulsion systems increases, however, similar modification programs to additional test cells in these plants as well as in other design bureaus and production facilities may be observed.

Kuybyshev Plant 2 (Figure 3)

10. At one of the major engine test buildings in Kuybyshev Experimental Aircraft and Rocket Engine Plant Krasnaya Glinka 2, two horizontal attached silencers have been replaced by four (two pairs) square exhaust towers. The new towers at Plant 2 have a tapered base. A diffuser tube connects the base of each pair of towers to its respective test cell. The diffuser tubes and extend approximately 80 feet from the test cells to the towers. 25X1 25X1

11. The square exhaust towers at Plant 2 were first observed under construction in August 1970. In August 1973, the latest coverage of the plant, one pair of towers appeared complete and one pair was in a late construction stage.

12. Kuybyshev Plant 2 is the location of the N.D. Kuznetsov design bureau (OKB). The Kuznetsov organization is one of the major Soviet aircraft engine design teams and is associated with the design and production of turboprop and turbofan engines. The Kuznetsov OKB designed and produced the NK-144 turbofan engine which powers the TU-144 supersonic transport.[2]

Kuybyshev Plant 24 (Figure 4)

13. Six of the square exhaust towers have been installed at Kuybyshev Aircraft Engine Plant Frunze 24. The towers and have tapered bases. Four towers are on a large multicell sea-level engine test building and two are on a smaller double-cell engine test building. The presence of a compressor building and air bottles indicates that the double-cell engine test building may have an altitude simulation capability. 25X1

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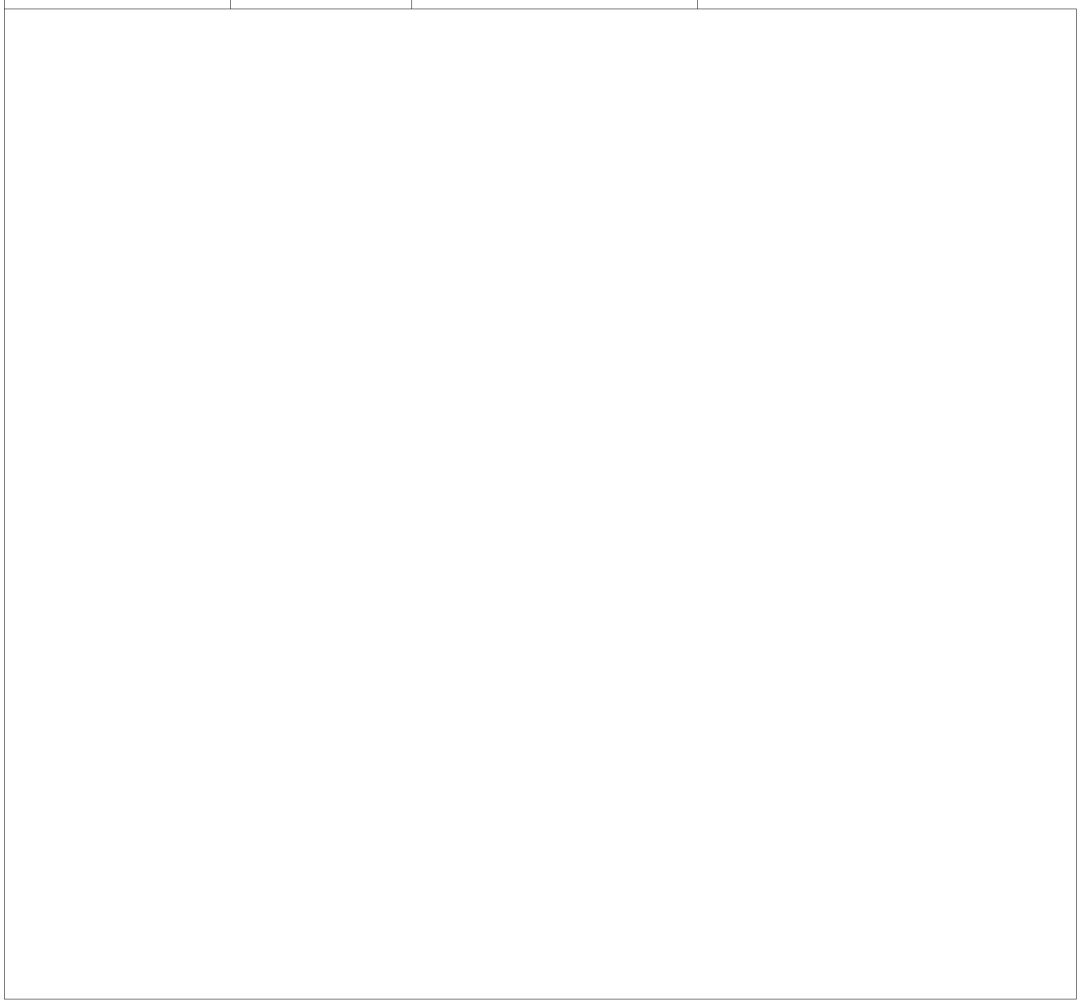


14. The six towers at Plant 24 are situated in three pairs. Each pair appears to serve one test cell. At the large sea-level test building one pair of towers is connected to the test cell by a diffuser tube. An adjacent pair of towers is almost flush against the test cell building; however, this test cell building is longer and probably has an internal diffuser tube. The probable altitude simulation test cell building has a diffuser tube with a 16-foot diameter which extends 95 feet from the test cell building to the base of the third pair of exhaust towers.

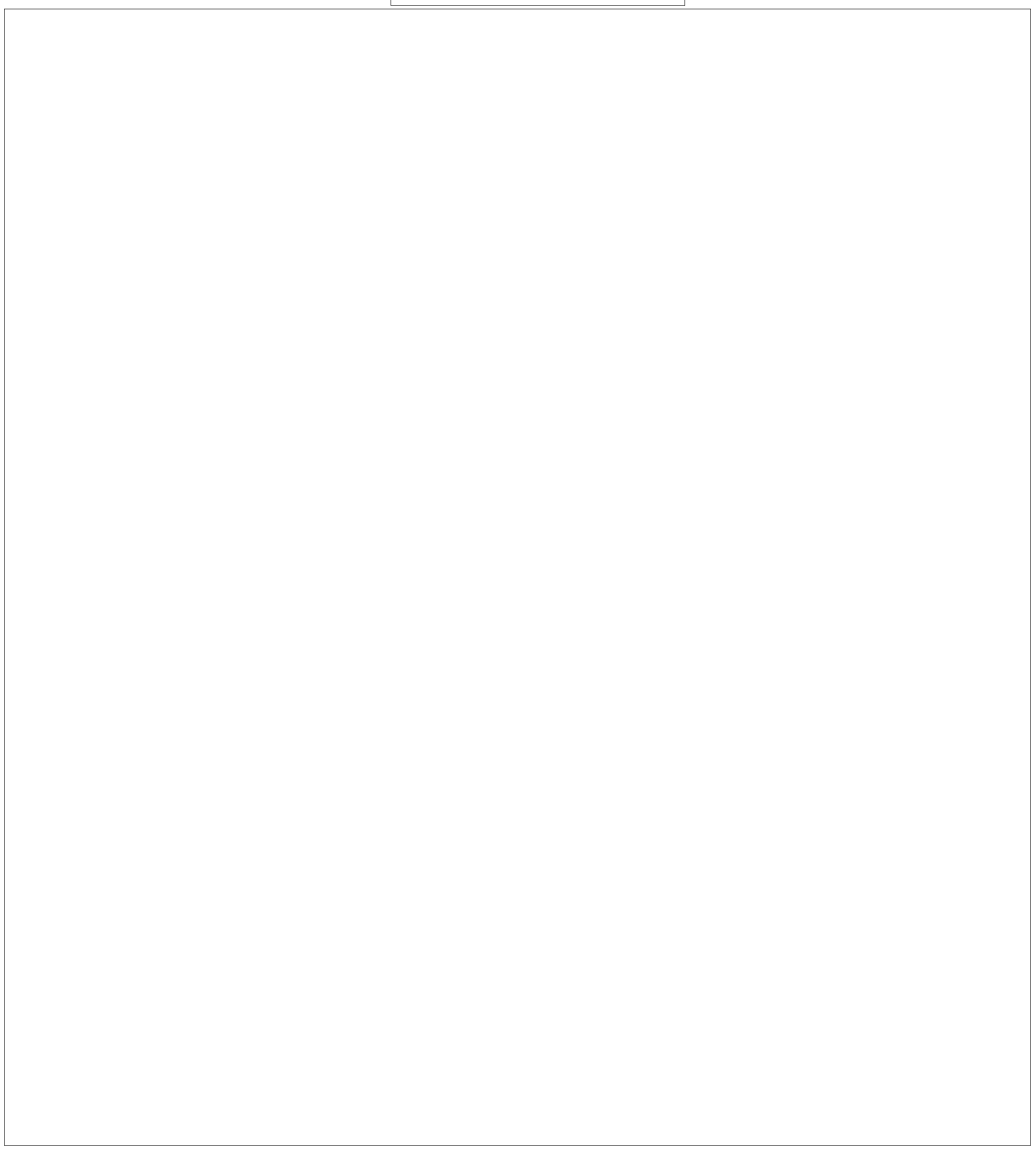
15. All of the test cells at Plant 24 formerly employed the straight-through exhaust system, indicating that they were sea-level facilities for testing propeller or turboprop engines.

16. The square exhaust towers were first observed under construction at Plant 24 in August 1969. By August 1971 all six towers were complete and probably operational.

17. Kuybyshev Plant 24 is considered the series production plant for engines designed by the Kuznetsov OKB at Kuybyshev Plant 2.[2] However, the indications of altitude simulation capability at Plant 24 and the construction of the square exhaust towers during the same time period at Plants 2 and 24 suggest that some design activity may take place at Plant 24.

Moscow Plant 45 (Figure 5)

18. Moscow Aircraft Engine Plant 45 has seven of the square exhaust towers, all of which replaced the older cylindrical exhaust towers. The upper portion of the new towers is identical to the towers at the other plants in this report; however, shadows obscure the lower portions of the towers, precluding detailed description of the tower bases. Diffuser tubes apparently connect the test cells and exhaust towers, but because of poor interpretability these connections were not discernible.



19. Two of the square towers at Plant 45 were installed between 1966 and 1969 (limited coverage precludes the determination of exact dates). Construction began on five additional square towers in September 1970 and was completed by March 1972.

20. Moscow Plant 45 is considered one of the series production plants for engines designed by the Tumanskiy OKB at Aircraft Engine Experimental Plant Luznetskaya 300 FOXBAT engine crates have been identified at Plant 45.[1] The limited engine test facilities at Plant 300 and the development by the Tumanskiy team of the high-thrust turbojet engine for the FOXBAT indicate that the test cells at Plant 45 are also being used in support of design activities.

Rybinsk Plant 36 (Figure 6)

21. Only one square exhaust tower has been installed at Rybinsk Aircraft Engine Plant 36. The top of this tower has never been covered and the four shafts exhaust vertically into the atmosphere. The base of the tower is cylindrical, 25 feet in diameter, and is connected to the test cell building by a diffuser tube 130 feet long

22. The square exhaust tower was first observed at Plant 36 in October 1966. The tower was complete at that time but the connecting diffuser tube had not been installed. The diffuser tube had been installed by the next clear coverage of Plant 36 in March 1968.

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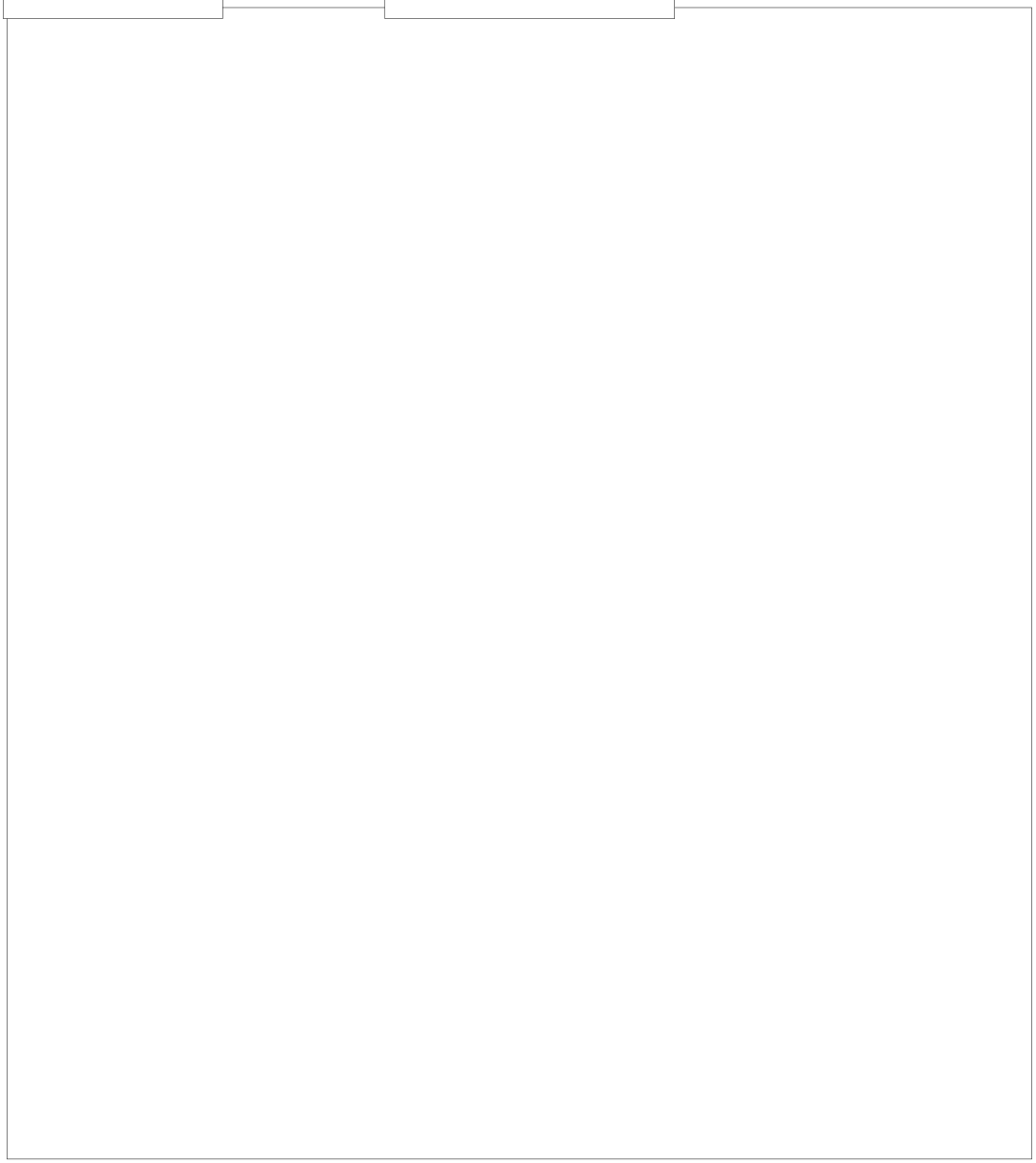

23. Rybinsk Plant 36 is a production facility for Tumanskiy-designed engines; FOXBAT engine crates have also been identified here.[1]

Perm Plant 19 (Figure 7)

24. Two square exhaust towers have been installed on the double-cell engine test building at Perm Aircraft Engine Plant Stalin 19. The square towers replaced older cylindrical towers. The square towers are 89 feet high and have cylindrical bases 25 feet in diameter. A diffuser tube 25X1
extends 40 feet from the base of one of the exhaust towers to the test cell building. The 25X1
other exhaust tower is positioned flush against the test cell building.

25. The first square exhaust tower at Plant 19 was observed under construction in July 1972. By December 1972 this square exhaust tower was complete and the old cylindrical exhaust tower had been reassembled in an adjacent position. A diffuser tube with extends 25X1
approximately 65 feet from the reassembled cylindrical exhaust tower and curves into the side of the same test cell section that is served by the square exhaust tower. The second square exhaust tower at Perm was complete when first observed in January 1974.

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26. Plant 19 is the location of the Solovyev OKB. P.A. Solovyev is one of the leading Soviet designers of turbofan engines. He designed and produced the D-20 and D-30 series turbofan engines which power many of the Soviet jet transports.[1]

Omsk Plant 29 (Figure 8)

27. At Omsk Aircraft and Missile Engine Plant Baranova 29 a completely new engine test building was constructed which incorporated the square exhaust towers.[3] It is a double-cell test building with two intake towers, two secondary intake towers, and two square exhaust towers. The exhaust towers are [redacted] have cylindrical bases 25 feet in diameter. Diffuser tubes 20 feet in diameter extend approximately 110 feet from the base of the exhaust towers to the secondary intake towers at the engine test cell building. 25X1

Moscow Aircraft Engine Research Center

28. Moscow Aircraft Engine Research Center Myachkovo, TsIAM, has three of the square exhaust towers, all of which replaced older cylindrical exhaust towers. All three square exhaust towers are connected to individual test cells by diffuser tubes. The square towers were installed at the research

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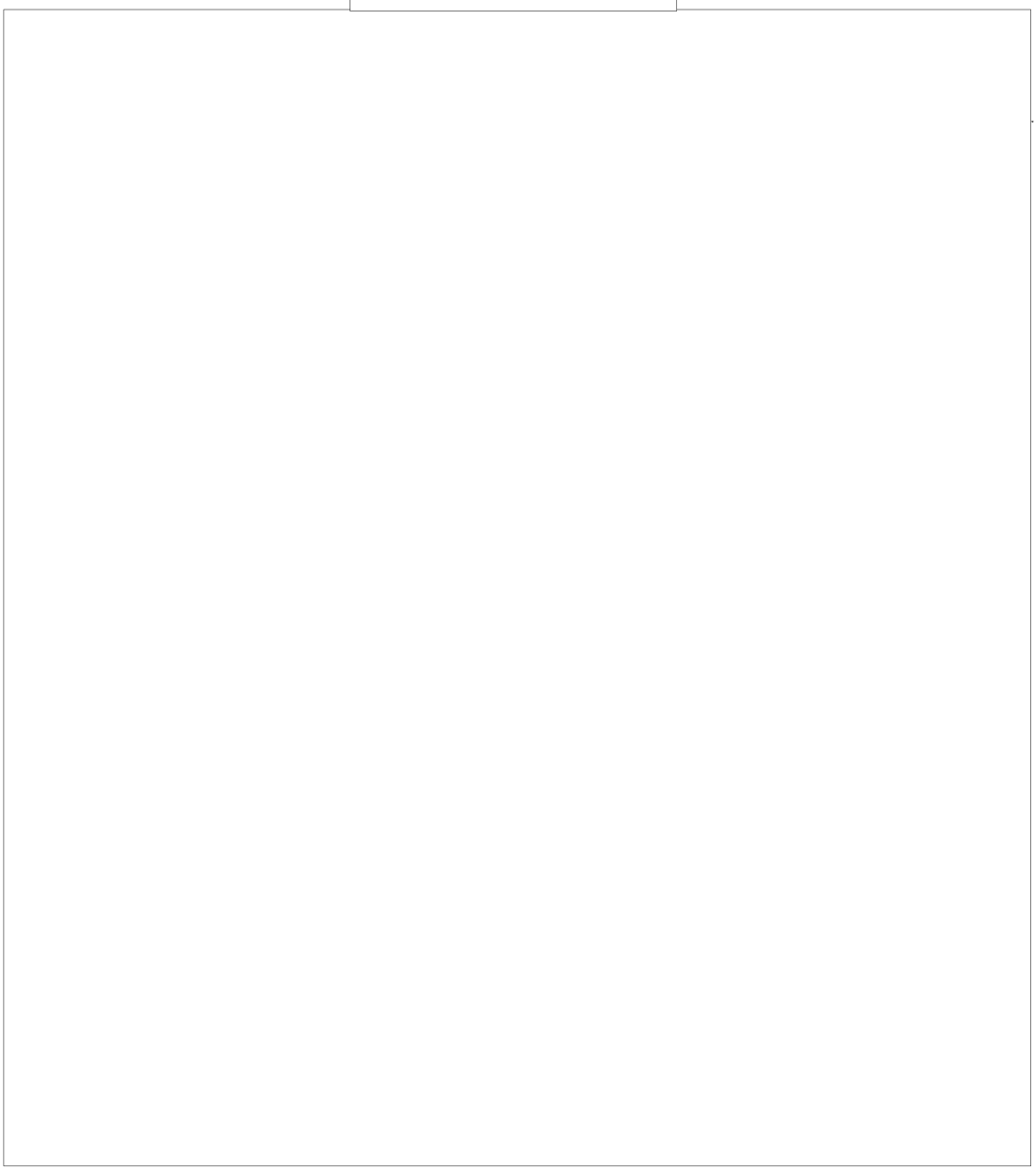

center between May 1967 and August 1970. Limited large-scale photography precludes a more detailed history and analysis of the square exhaust towers at the research center.

29. The Moscow research center is the major R&D facility for aircraft engines in the Soviet Union. The center has the primary responsibility for the formulation of design criteria and evaluation of experimental engines built by the design bureaus. This relationship requires that any improvement of engine test capabilities at design bureaus or production plants be paralleled by comparable improvements at the research center.[2]

REFERENCES

MAPS OR CHARTS

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3. NPIC PIN-017/73, *Engine Test Building Under Construction at Omsk Aircraft and Missile Engine Plant Baranova 29,* Mar 73 (TOP SECRET RUFF)

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RELATED DOCUMENT

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REQUIREMENT

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